Notice that the program creates two stacks: one five elements deep and the other eight elements deep. As you can see, the fact that arrays maintain their own length information makes it easy to create stacks of any size.

Introducing Nested and Inner Classes

It is possible to define a class within another class; such classes are known as *nested classes*. The scope of a nested class is bounded by the scope of its enclosing class. Thus, if class B is defined within class A, then B does not exist independently of A. A nested class has access to the members, including private members, of the class in which it is nested. However, the enclosing class does not have access to the members of the nested class. A nested class that is declared directly within its enclosing class scope is a member of its enclosing class. It is also possible to declare a nested class that is local to a block.

There are two types of nested classes: *static* and *non-static*. A static nested class is one that has the **static** modifier applied. Because it is static, it must access the non-static members of its enclosing class through an object. That is, it cannot refer to non-static members of its enclosing class directly. Because of this restriction, static nested classes are seldom used.

The most important type of nested class is the *inner* class. An inner class is a non-static nested class. It has access to all of the variables and methods of its outer class and may refer to them directly in the same way that other non-static members of the outer class do.

The following program illustrates how to define and use an inner class. The class named **Outer** has one instance variable named **outer_x**, one instance method named **test( )**, and defines one inner class called **Inner**.

```
// Demonstrate an inner class.
class Outer {
  int outer_x = 100;

  void test() {
    Inner inner = new Inner();
    inner.display();
  }

  // this is an inner class
  class Inner {
    void display() {
      System.out.println("display: outer_x = " + outer_x);
    }
  }
}

class InnerClassDemo {
  public static void main(String args[]) {
    Outer outer = new Outer();
    outer.test();
  }
}
```

Output from this application is shown here:

```
display: outer_x = 100
```

In the program, an inner class named **Inner** is defined within the scope of class **Outer**. Therefore, any code in class **Inner** can directly access the variable **outer_x**. An instance method named **display( )** is defined inside **Inner**. This method displays **outer_x** on the standard output stream. The **main( )** method of **InnerClassDemo** creates an instance of class **Outer** and invokes its **test( )** method. That method creates an instance of class **Inner** and the **display( )** method is called.

It is important to realize that an instance of **Inner** can be created only in the context of class **Outer**. The Java compiler generates an error message otherwise. In general, an inner class instance is often created by code within its enclosing scope, as the example does.

As explained, an inner class has access to all of the members of its enclosing class, but the reverse is not true. Members of the inner class are known only within the scope of the inner class and may not be used by the outer class. For example,

```
// This program will not compile.
class Outer {
  int outer_x = 100;

  void test() {
    Inner inner = new Inner();
    inner.display();
  }

  // this is an inner class
  class Inner {
    int y = 10; // y is local to Inner

    void display() {
      System.out.println("display: outer_x = " + outer_x);
    }
  }

  void showy() {
    System.out.println(y); // error, y not known here!
  }
}

class InnerClassDemo {
  public static void main(String args[]) {
    Outer outer = new Outer();
    outer.test();
  }
}
```

Here, **y** is declared as an instance variable of **Inner**. Thus, it is not known outside of that class and it cannot be used by **showy( )**.

Although we have been focusing on inner classes declared as members within an outer class scope, it is possible to define inner classes within any block scope. For example, you can define a nested class within the block defined by a method or even within the body of a **for** loop, as this next program shows:

```
// Define an inner class within a for loop.
class Outer {
  int outer_x = 100;

  void test() {
    for(int i=0; i<10; i++) {
      class Inner {
        void display() {
          System.out.println("display: outer_x = " + outer_x);
        }
      }
      Inner inner = new Inner();
      inner.display();
    }
  }
}

class InnerClassDemo {
  public static void main(String args[]) {
    Outer outer = new Outer();
    outer.test();
  }
}
```

The output from this version of the program is shown here:

```
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
display: outer_x = 100
```

While nested classes are not applicable to all situations, they are particularly helpful when handling events. We will return to the topic of nested classes in Chapter 24. There you will see how inner classes can be used to simplify the code needed to handle certain types of events. You will also learn about *anonymous inner classes*, which are inner classes that don't have a name.

One final point: Nested classes were not allowed by the original 1.0 specification for Java. They were added by Java 1.1.